

Job Outlook

Overall employment of surveyors, cartographers, photogrammetrists, and surveying technicians is expected to grow about as fast as the average through the year 2008. The widespread availability and use of advanced technologies, such as the Global Positioning System, Geographic Information Systems, and remote sensing, are increasing both the accuracy and productivity of survey and mapping work. Job openings, however, will continue to result from the need to replace workers who transfer to other occupations or leave the labor force altogether.

Prospects will be best for surveying technicians, whose growth is expected to be slightly faster than the average for all occupations through 2008. The short training period needed to learn to operate the equipment, the current lack of any formal testing or licensing, and the relatively lower wages all make for a healthy demand for these technicians, as well as for a readily available supply.

As technologies become more complex, opportunities will be best for surveyors, cartographers, and photogrammetrists who have at least a bachelor's degree and strong technical skills. Increasing demand for geographic data, as opposed to traditional surveying services, will mean better opportunities for cartographers and photogrammetrists involved in the development and use of geographic and land information systems. New technologies, such as GPS and GIS may also enhance employment opportunities for surveyors and surveying technicians who have the educational background enabling them to use these systems, but upgraded licensing requirements will continue to limit opportunities for those with less education.

Even as demand increases in nontraditional areas such as urban planning and natural resource exploration and mapping, opportunities for surveyors, cartographers, and photogrammetrists should remain concentrated in engineering, architectural, and surveying services firms. Growth in construction through 2008 should require surveyors to lay out streets, shopping centers, housing developments, factories, office buildings, and recreation areas. However, employment may fluctuate from year to year along with construction activity.

Earnings

Median annual earnings of surveyors, cartographers, and photogrammetrists were \$37,640 in 1998. The middle 50 percent earned between \$27,580 and \$50,380. The lowest 10 percent earned less than \$21,510 and the highest 10 percent earned more than \$76,880.

Median hourly earnings of surveying technicians were \$11.20 in 1997 for those employed in engineering and architectural services, while those employed by local governments received median hourly earnings of \$13.50. The middle 50 percent of all surveying technicians earned between \$9.86 and \$16.54 in 1998. The lowest 10 percent earned less than \$7.61 and the highest 10 percent earned more than \$21.14.

In 1999, land surveyors in nonsupervisory, supervisory, and managerial positions in the Federal Government earned an average salary of \$52,400; cartographers earned an average salary of \$56,300. The average Federal salary for geodetic technicians is \$48,800; for surveying technicians, about \$31,300; and for cartographic technicians, about \$37,200.

Related Occupations

Surveying is related to the work of civil engineers and architects, since an accurate survey is the first step in land development and construction projects. Cartography and geodetic surveying are related to the work of geologists and geophysicists, who study the earth's internal composition, surface, and atmosphere. Cartography is also related to the work of geographers and urban planners, who study and decide how the earth's surface is used.

Sources of Additional Information

Information about career opportunities, licensure requirements, and the surveying technician certification program is available from:

✦ American Congress on Surveying and Mapping, 5410 Grosvenor Lane, Suite 100, Bethesda, MD 20814-2122.

General information on careers in photogrammetry is available from:

✦ ASPRS: The Imaging and Geospatial Information Society, 5410 Grosvenor Lane, Suite 210, Bethesda, MD 20814.

General information on careers in cartography is available from:

✦ North American Cartographic Information Society, P.O. Box 399, Milwaukee, WI 53201-0399.

Computer, Mathematical, and Operations Research Occupations

Actuaries

(O*NET 25313)

Significant Points

- A strong background in mathematics is essential for an actuary.
- About 2 out of 3 actuaries are employed in the insurance industry.
- Employment opportunities will be good despite the limited number of openings in this small occupation as stringent qualifying requirements induced by the examination system limit the number of new entrants.

Nature of the Work

Actuaries are essential employees because they determine future risk, make price decisions, and formulate investment strategies. Some actuaries also design insurance, financial, and pension plans and ensure that these plans are maintained on a sound financial

basis. Most actuaries specialize in life and health or property and casualty insurance; others work primarily in finance or employee benefits. Some use a broad knowledge of business and mathematics in investment, risk classification, or pension planning.

Regardless of specialty, actuaries assemble and analyze data to estimate probabilities of an event taking place, such as death, sickness, injury, disability, or property loss. They also address financial questions, including the level of pension contributions required to produce a certain retirement income level or the projected future return on investments. Moreover, actuaries may help determine company policy and sometimes explain complex technical matters to company executives, government officials, shareholders, policyholders, or the public in general. They may testify before public agencies on proposed legislation affecting their businesses or explain changes in contract provisions to customers. They also may help companies develop plans to enter new lines of business.

Most actuaries are employed in the insurance industry, in which they estimate the amount a company will pay in claims. For example, property/casualty actuaries calculate the expected amount of claims resulting from automobile accidents, which varies depending on the insured person's age, sex, driving history, type of car, and other factors. Actuaries ensure that the price, or premium,

charged for such insurance will enable the company to cover claims and other expenses. This premium must be profitable and yet competitive with other insurance companies.

Actuaries employed in other industries perform several different functions. The small but growing group of actuaries in the financial services industry, for example, manages credit and helps price corporate security offerings. Because banks now offer their customers investment products such as annuities and asset management services, actuaries increasingly help financial institutions manage the substantial risks associated with these products. Actuaries employed as pension actuaries enrolled under the provisions of the Employee Retirement Income Security Act of 1974 (ERISA) evaluate pension plans covered by that act and report on their financial soundness to plan members, sponsors, and Federal regulators.

In addition to salaried actuaries, numerous consulting actuaries provide advice to clients on a contract basis. Their clients include insurance companies, corporations, health maintenance organizations, health care providers, government agencies, and attorneys. The duties of most consulting actuaries are similar to those of other actuaries. For example, some design pension plans through calculating the future value of current deductions from earnings and determining the amount of employer contributions. Others provide advice to health care plans or financial services firms. Consultants sometimes testify in court regarding the value of potential lifetime earnings of a person who is disabled or killed in an accident, the current value of future pension benefits in divorce cases, or other complex calculations. Many consulting actuaries work in reinsurance, where one insurance company arranges to share a large prospective liability policy with another insurance company in exchange for a percentage of the premium.

Working Conditions

Actuaries have desk jobs, and their offices are usually comfortable and pleasant. They often work at least 40 hours a week. Some actuaries, particularly consulting actuaries, may travel to meet with clients. Consulting actuaries may also experience more erratic employment and be expected to work more than 40 hours per week.

Employment

Actuaries held about 16,000 jobs in 1998. Almost one-half of the actuaries who were wage and salary workers were employed in the insurance industry. Some had jobs in life and health insurance companies, while property and casualty insurance companies, pension funds, or insurance agents and brokers employed others. Most of the remaining actuaries worked for firms providing services, espe-

cially management and public relations, or for actuarial consulting services. A relatively small number of actuaries were employed by security and commodity brokers or government agencies. Some developed computer software for actuarial calculations. In 1998, 2,300 actuaries were self-employed.

Training, Other Qualifications, and Advancement

Applicants for beginning actuarial jobs usually have a bachelor's degree in mathematics, actuarial science, statistics, or a business-related discipline, such as economics, finance, or accounting. About 55 colleges and universities offer an actuarial science program, and most colleges and universities offer a degree in mathematics or statistics. Some companies hire applicants without specifying a major, provided that the applicant has a working knowledge of mathematics, including calculus, probability, and statistics, and has demonstrated this ability by passing at least the beginning few actuarial exams required for professional designation. Courses in economics, accounting, computer science, finance, and insurance are also useful. Companies increasingly prefer well-rounded individuals who, in addition to a strong technical background, have some training in liberal arts and business.

Two professional societies sponsor programs leading to full professional status in their specialty. The first, the Society of Actuaries (SOA), administers a series of actuarial examinations for the life and health insurance, pension, and finance and investment fields. The Casualty Actuarial Society (CAS), on the other hand, gives a series of examinations for the property and casualty field, which includes fire, accident, medical malpractice, workers compensation, and personal injury liability.

The first parts of the SOA and CAS examination series are jointly sponsored by the two societies and cover the same material. For this reason, students do not need to commit themselves to a specialty until they have taken the initial examinations. These examinations test an individual's competence in probability, calculus, statistics, and other branches of mathematics. The first few examinations help students evaluate their potential as actuaries. Those who pass one or more examinations have better opportunities for employment at higher starting salaries than those who do not.

Actuaries are encouraged to complete the entire series of examinations as soon as possible, advancing first to the Associate level, and then to the Fellowship level. Advanced casualty topics include investment and assets, dynamic financial analysis, and valuation of insurance topics. Completion of the examination process usually takes from 5 to 10 years. Examinations are given twice a year, in May and November. Although many companies allot time to their employees for study, extensive home study is required to pass the examinations, and many actuaries study for months to prepare for each examination. It is likewise common for employers to pay the hundreds of dollars for fees and study materials. Most reach the Associate level within 4 to 6 years and the Fellowship level a few years later.

Specific requirements apply for pension actuaries, who verify the financial status of defined benefit pension plans to the Federal Government. These actuaries must be enrolled by the Joint Board for the Enrollment of Actuaries. To qualify for enrollment, applicants must meet certain experience and examination requirements, as stipulated by the Joint Board.

To perform their duties effectively, actuaries must keep up with current economic and social trends and legislation, as well as developments in health, business, finance, and economics that could affect insurance or investment practices. Good communication and interpersonal skills are also important, particularly for prospective consulting actuaries.

Beginning actuaries often rotate among different jobs in an organization to learn various actuarial operations and phases of insurance work, such as marketing, underwriting, and product development. At first, they prepare data for actuarial projects or perform other simple tasks. As they gain experience, actuaries



Using their broad knowledge of business and mathematics, actuaries work in investment, risk classification, and employee benefits.

may supervise clerks, prepare correspondence, draft reports, and conduct research. They may move from one company to another early in their careers as they move up to higher positions.

Advancement depends largely on job performance and the number of actuarial examinations passed. Actuaries with a broad knowledge of the insurance, pension, investment, or employee benefits fields can advance to administrative and executive positions in their companies. Actuaries with supervisory ability may advance to management positions in other areas, such as underwriting, accounting, data processing, marketing, or advertising. Some actuaries assume faculty positions in the Nation's colleges and universities. (See the statement on college and university faculty elsewhere in the *Handbook*.)

Job Outlook

Employment of actuaries is expected to grow more slowly than the average for all occupations through 2008. Although expected growth in managed health plans in the health services industry should provide good prospects for actuaries, anticipated downsizing and merger activity in the insurance agent and broker industry will adversely affect the outlook for these workers. Prospective actuaries who pass several beginning actuarial exams will find relatively few job openings. The number of openings to replace those who leave the occupation each year is limited and new openings are restricted by the relatively small size of the occupation.

Actuarial employment is projected to grow in property and casualty insurance as this sector experiences growth in terms of employment and billing. Actuaries will continue to be involved in the development of product liability insurance, medical malpractice, and workers' compensation coverage. The development of new financial tools such as dynamic financial analysis has increased the demand for property and casualty actuaries. The growing need to evaluate catastrophic risks such as earthquakes and calculate prices for insuring facilities against such risks is another source of increasing demand for property and casualty actuaries. Planning for the systematic financing of environmental risks, such as toxic waste clean-up, will further lift demand for actuaries in this specialty.

Employment of consulting actuaries is expected to grow faster than employment of actuaries among life insurance carriers—traditionally the leading employer of actuaries. As many life insurance carriers seek to boost profitability by streamlining operations, actuarial employment may be cut back. Investment firms and large corporations may increasingly turn to consultants to provide actuarial services formerly performed in-house.

Earnings

Median annual earnings of actuaries were \$65,560 in 1998. The middle 50 percent earned between \$45,560 and \$89,860. The lowest 10 percent had earnings of less than \$36,000, while the top 10 percent earned over \$123,810. The average salary for actuaries employed by the Federal government was \$72,800 in early 1999. According to the National Association of Colleges and Employers, annual starting salaries for bachelor's degree graduates in mathematics/actuarial science averaged about \$37,300 in 1999.

Insurance companies and consulting firms give merit increases to actuaries as they gain experience and pass examinations. Some companies also offer cash bonuses for each professional designation achieved. A 1998 salary survey of insurance and financial services companies, conducted by the Life Office Management Association, Inc., indicated that the average base salary for an entry-level actuary with the largest U. S. companies was about \$41,500. Associate Actuaries with the largest U. S. companies, who direct and provide leadership in the design, pricing, and implementation of insurance products, received an average salary of \$88,000. Actuaries at the highest technical level without managerial responsibilities in the same size companies earned an average of \$101,600.

Related Occupations

Actuaries determine the probability of income or loss from various risk factors. Other workers whose jobs involve related skills include accountants, economists, financial analysts, mathematicians, and statisticians.

Sources of Additional Information

For facts about actuarial careers, contact:

☛ American Academy of Actuaries, 1100 17th St. NW., 7th Floor, Washington, DC 20036. Internet: <http://www.actuary.org/index.htm>

For information about actuarial careers in life and health insurance, employee benefits and pensions, and finance and investments, contact:

☛ Society of Actuaries, 475 N. Martingale Rd., Suite 800, Schaumburg, IL 60173-2226. Internet: <http://www.soa.org>

For information about actuarial careers in property and casualty insurance, contact:

☛ Casualty Actuarial Society, 1100 N. Glebe Rd., Suite 600, Arlington, VA 22201. Internet: <http://www.casact.org>

Career information on actuaries specializing in pensions is available from:

☛ American Society of Pension Actuaries, 4350 N. Fairfax Dr., Suite 820, Arlington, VA 22203. Internet: <http://www.aspa.org>

Computer Systems Analysts, Engineers, and Scientists

(O*NET 21114C, 22127, 25102, 25103A, 25104, and 25199A)

Significant Points

- As computer applications continue to expand, these occupations are projected to be the fastest growing and rank among the top 20 in the number of new jobs created over the 1998-2008 period.
- Relevant work experience and a bachelor's degree are prerequisites for many jobs; for more complex jobs, a graduate degree is preferred.

Nature of the Work

The rapid spread of computers and information technology has generated a need for highly trained workers to design and develop new hardware and software systems and to incorporate new technologies. These workers—computer systems analysts, engineers, and scientists—include a wide range of computer-related occupations. Job tasks and occupational titles used to describe this broad category of workers evolve rapidly, reflecting new areas of specialization or changes in technology, as well as the preferences and practices of employers.

Systems analysts solve computer problems and enable computer technology to meet individual needs of an organization. They help an organization realize the maximum benefit from its investment in equipment, personnel, and business processes. This process may include planning and developing new computer systems or devising ways to apply existing systems' resources to additional operations. Systems analysts may design new systems, including both hardware and software, or add a new software application to harness more of the computer's power. Most systems analysts work with a specific type of system that varies with the type of organization they work for—for example, business, accounting or financial systems, or scientific and engineering systems. Systems development workers are also referred to as a *systems developer* and *systems architect*.

Analysts begin an assignment by discussing the systems problem with managers and users to determine its exact nature. They